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FACULTY WORKING
PAPER NO. 1250

Discordant Beliefs and Trading Activity In the Stock Options Market: Some Preliminary Empirical Evidence

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PAPER NO. 1261

Reputation and Uncertainty: Towards an Explanation of Quality Problems in Competitive Markets

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June 1986

Reputation and Uncertainty: Towards an Explanation of Quality Problems in Competitive Markets

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Abstract

This paper attempts to explain the puzzle of low and variable qualities in seemingly competitive markets. We show that under cost or demand uncertainty in a market with free entry, reputation may not be sufficient to solve the problem of asymmetric information. Since markets with a multiplicity of producers are more likely to suffer from cost and demand uncertainties, they are also more susceptible to suffering from quality problems as well. The derived conditions for the persistence of quality problems furthermore contribute to the explanation of quality differences between similar markets in developed and less developed countries.

REPUTATION AND UNCERTAINTY: TOWARDS AN EXPLANATION OF QUALITY PROBLEMS IN COMPETITIVE MARKETS

I. Introduction

Markets with imperfect information have a potential for failure. For example, in markets where product quality is not observable at the time of purchase, sellers have an incentive to sell 'lemons' in place of more costly high quality products. However, institutions such as reputation often appear in these markets and generate proper incentives for the maintenance of preferred quality levels. Sellers who forego the benefits of cheating earn a reputation which allows them to charge a premium over the cost of production. This premium is the cost of correcting the information problem in the marketplace, and buyers should be willing to pay for it if they prefer quality products (Klein and Leffler, 1981). In a competitive market, the quality premium may alternatively be interpreted as the return on investment in reputation (Shapiro, 1983).

Despite these apparent possibilities of correcting information problems at a cost, there are many markets which persistently suffer from variable and poor quality, without the market failing altogether or market institutions such as reputation solving the problem. Rashid (1985) provides an interesting documentation of several such cases, ranging from the non-uniform quality cloth in the pre-Industrial Revolution England to the diluted milk and pebble-blended rice in the contemporary less developed countries. A notable common characteristic of the cases examined by Rashid is that they are all markets with a multiplicity of small producers and with free entry. This

observation is quite puzzling, since these characteristics are often associated with perfect competition where one expects consumer sovereignty. Low quality in some markets may of course be due to low consumer incomes and their preferences. However, in most of Rashid's examples this is unlikely to be the case. In the milk market, for example, it is not at all clear why consumers would want to buy diluted milk, while they can add water to the pure milk themselves; the cleanness of the process is going to be more certain and the cost may even be lower. Similarly, consumers' complaints about cheating and about variability of quality are also hard to explain on the basis of preferences [1].

Akerlof (1970) who has been puzzled by his observations of quality problems in India, seems to suggest that scarcity of entreprenuerial skills may prevent LDC producers from building up reputation and capitalizing on honesty. It is, however, rather difficult to believe that the pursuit of simple rules of honesty should require greater skills than the maintenance of a business based on repeated cheatings. Moreover, it seems natural that consumers should punish dishonest sellers by not buying, and reward the honest ones by showing a willingness to pay for quality. This should instinctively teach the value of reputation to the sellers. It is true that such mechanisms may not work where consumers cannot identify the sellers or do not make repeated purchases, but this is obviously not the case in the type of markets that have puzzled us. The question, thus, remains why despite strong incentives, reputation does not take root in these markets, and if it fails, why these markets do not produce the (uniform) lowest

possible qualities only, and why their qualities tend to vary from time to time and from seller to seller.

Persistent quality problems may of course have sociological explanations where consumers are not quite rational and stand to lose as a result. For example, in choosing where to buy, consumers may be motivated by advertising (Schmalensee, 1978) or by market shares (Smallwood and Conlisk, 1979). While there may be some truth in these assumptions, it is hard to believe that in the long run consumers concentrate on gathering such information as opposed to the more relevant ones; e.g., the sellers' past performance and their incentives to maintain quality.

Quality problems may also persist if a group of consumers fails to gather information about sellers' reputations, and thus falls victim to the dishonest ones (Salop and Stiglitz, 1977; Grossman and Stiglitz, 1980; Chan and Leland, 1982; Cooper and Ross, 1984; Schwartz and Wilde, 1985). In this class of models with asymmetric information, there is always an informed group of consumers that supports the business of honest sellers and keeps the market for the high quality products functioning. Uninformed consumers, on the other hand, find information gathering too costly and, thus, act as free-riders while running the risk of ending up with low quality products. These models, although useful for other purposes, are not well equipped for explaining the type of quality problems we are considering here. In particular, the assumed dichotomy between consumers seems quite strong: while one group of consumers is well informed and, thus, is never cheated, the other groups who remain uninformed--by choice or by

inherent handicaps--are the only potential preys for the dishonest sellers.

Our purpose in this paper is to explore possible explanations of persistent quality problems in markets with asymmetric information. We argue, in Section III, that in the presence of cost uncertainty in a competitive market, sellers may not find it worthwhile to maintain their reputations. This can give rise to variability of product quality and also discourage risk-averse consumers from paying a high price for a high quality. We will show that the characteristics of such markets match those of the problematic ones described by Rashid. An extension of our main argument to the case of demand uncertainty in monopolistically competitive markets and a generalization of our model are provided in Section IV. Section V, at the end, summarizes the paper. In the next section, we begin our discussion with a simple model of reputation in order to describe the role of this institution in correcting certain market failures, and to formulate our problem more precisely. This model is a modified version of the example analyzed by Shapiro (1983).

II. The Role of Reputation in Markets with Asymmetric Information

In order to see how reputation can help solve a potential market failure, consider a product with quality characteristics that can be observed only after purchase. In such a market, if quality is costly to produce and if sellers are not identifiable, buyers have no economic reason to expect anything but the lowest possible quality. Even if they are willing to pay more for a higher quality and offer a potential gain to the seller, they cannot expect the seller not to

cheat. Therefore, the market for the high quality product fails to exist, and many mutually beneficial transaction are blocked by the fact that the buyers cannot trust the sellers. The main problem is that sellers can cheat with impunity. However, if sellers are identifiable, the problem may be solved by a combination of a premium profit for quality and a boycott in case of cheating. A simple version of this mechanism can be built in the following manner. Assume that in a competitive market, a seller's reputation in each period, R_t, depends only on the quality he has marketed in the previous period, q_{t-1}, [2]:

(1) $$R_t = q_{t-1}.$$

Also, assume that each seller produces one unit of the product in each period, with the cost depending on quality. The cost function will be represented by c(q), with $c' > 0$ and $c'' \geq 0$. Furthermore, assume that there is a minimal quality q_0 below which sellers cannot produce or sell successfully. Similarly, there is an upper bound q_m which represents the maximum feasible quality.

If the price paid for quality q is p(q), the seller can earn $p(q) - c(q)$ as "pure" profits each period as long as he maintains quality q. The seller chooses such a strategy if the expected present value of profits over the life-time of his business is found to be higher than all other alternative strategies. To keep the algebra simple, instead of choosing a fixed life-time, we assume that there is a probability e that the seller may leave the market at the end of each period due to exogenous factors. Note that this implies an expected life-time of 1/e periods for the firm. Therefore, the expected

present value of the quality-maintenance strategy, $V_M(q)$, can be calculated from:

(2) $$V_M(q) = p(q) - c(q) + (1-e)V_M(q)/(1+r),$$

where r is the rate of interest. Equation (2) states that the present value of the strategy M is equal to the profits made in the current period plus the discounted expected value of the strategy at the end of the period. Solving (2) for $V_M(q)$ results in:

(3) $$V_M(q) = [p(q)-c(q)](1+r)/(r+e).$$

A seller with reputation q can earn $V_C(q) = p(q) - c(q_0)$ by cheating in one period which gives him reputation q_0 in the following period and zero expected profits thereafter [3]. The seller will have no incentive to cheat if $V_M(q) \geq V_C(q)$. It is easy to see that this happens only when

(4) $$p(q) \geq c(q) + [c(q)-c(q_0)](r+e)/(1-e).$$

Inequality (4) puts a lower bound on the price of each quality, below which the seller of that quality will prefer to milk his reputation.

The free-entry condition of a competitive market, however, implies that potential profits for new entrants cannot be positive. Since reputation q can be established by selling quality q at the entry price p_e for one period, we must have

(5) $$p_e - c(q) + (1-e)V_M(q)/(1+r) \leq 0.$$

Or, equivalently, an upper bound on p(q):

(6) $\quad p(q) \leq c(q) + [c(q)-p_e](r+e)/(1-e),$

which can be found after substitution from (3) into (5). We now argue that

(7) $\quad p_e = c(q_0)$

which implies the coincidence of the lower and upper bounds of $p(q)$. First, note that p_e cannot be greater than $c(q_0)$, otherwise some sellers will end up selling the minimal quality and making a profit. Second, $p_e < c(q_0)$ can be ruled out because no equilibrium entry quality can exist in this case. The reason is that if entrants choose a quality q, buyers of that quality soon learn that entrants sell quality q at $p_e < p(q)$. They thus stop buying from the established sellers of q and go to the entrants only. But this in turn deters the entrants from establishing reputation q. Therefore, no quality will be able to serve as an entry quality. However, if $p_e = c(q_0)$, then some entrants will sell at quality q and others at q_0, so that a risk is created for the buyers of quality q who may be too optimistic about the entry quality [4].

Given equation (7), inequalities (4) and (6) imply:

(8) $\quad p(q) = c(q) + [c(q)-c(q_0)](r+e)/(1-e),$

which establishes the price-quality relationship faced by consumers. Note that the last term on the right-hand-side of (8) is a profit that sellers gain over the cost of production. This profit can be interpreted as the expected competitive return on the initial investment

that new entrants have to make in order to build up their reputation--i.e., $c(q) - c(q_0)$. This investment is a sunk cost for the seller and its function is to correct for the information problems in the market. Consumers, therefore, should be willing to pay the market rate of return on it if they prefer guaranteed quality [5].

Consumers in this simple model are all identical, and each one needs only one unit of the product under consideration. We define the utility function of a typical consumer as $U(u(q)+z)$, with $U' > 0$ and $U'' \leq 0$. In this utility function, $u(.)$ measures the preference for the quality of the product in terms of z which represents the aggregate quantity of all other goods that the consumer buys. By definition $u' > 0$, but u'' may be positive or negative depending on the nature of preferences. If the consumer's income is y and the price of z is normalized to unity, the utility function can be written as $U(u(q)+y-p(q))$. The price-quality relationship $p(q)$ is taken as given by the consumer and q is chosen such that the utility function is maximized. The first-order condition is:

$$(9) \qquad \partial U/\partial q = (u'-p')U' = 0 \quad \Rightarrow \quad u' = (1+r)c'/(1-e).$$

Note that on a p-q diagram, as in Figure 1, the family of consumer indifference curves can be represented by $k = u(q)-p+y$, where k is an indicator of the utility level. Obviously, as k rises, the indifference curve shifts to the right and the consumer attains higher levels of utility. Therefore, if an optimal quality such as $q^* < q_m$ exists, it will be determined at the point where an indifference curve becomes tangent to the price-quality relationship (8). Since the slope of the

indifference curves is u', it is easy to see that this is exactly what condition (9) requires. If, however, the solution to (9) turns out to be larger than the maximum feasible quality, then q_m will prevail in equilibrium, as depicted in Figure 2. Note that in general all points on the optimal indifference curve, except the point of tangency, lie below the price-quality schedule in the feasible range. Therefore, sellers will not be able to establish and maintain a profitable reputation at qualities other than q^*.

The second-order condition for utility maximization requires $\partial^2 U/\partial q^2 = (u''-p'')U' \leq 0$. Therefore, for the existence of an optimal quality we must have:

$$(10) \qquad u'' \leq (1+r)c''/(1-e).$$

Note that this condition will hold as long as u'' is negative. However, it will also hold if u'' is positive but relatively small. The situation in Figure 1 depicts a case where u'' is positive but less than $(1+r)c''/(1-e)$. If, on the other hand, u'' is positive and large, (10) may be violated, and the equilibrium will be established only at q_m (see Figure 2).

Conditions (9) and (10) indicate that with strong preference for quality, i.e., large u' and u'', a sub-maximal quality, and especially a low one, is more likely to exist only when the marginal cost of quality is rapidly rising, the interest rate is high, and the seller turnover is large. Note that these are the type of conditions that are more likely to exist in markets with numerous small producers. Small milk producers with one or two cows, for example, may easily go

out of business when they lose a cow, or sometimes, a family member. Since such high turnover also tends to raise the cost of credit, especially in the less developed economic environments, the above model provides some explanation for part of the quality problems documented by Rashid (1985). However, this model does not explain consumers' complaints about cheatings and the actual variability of quality which seems to support such claims. Neither does it satisfactorily answer questions such as the one about the diluted milk sales in some less developed economies. In fact, in the above model, consumers can be confident about what they buy as long as they are willing to pay for it. In the next section, we will argue that under uncertain cost conditions it may be impossible to trust the sellers, since they may find it profitable to lower their marketed qualities and risk their reputations whenever costs tend to rise.

Before we leave this section, however, it is worthwhile to note that the imposition of a minimum quality standard--which essentially raises q_0--can improve the performance of the market. In our model, due to the selected form of the utility function, the preferred market quality, q*, will always remain the same, but the premium will decline as the minimum standard rises. As Figure 3 shows, the minimum standard quality will be optimal at q*, and would only hurt the consumers beyond this point. The question of optimal quality standards would of course become more complicated if there are several distinct consumer groups. Relaxing the assumption of identical consumers, as in Shapiro (1983), does not change the essence of our results so far, since in that case, each consumer group, with its different u(q) and y, will

choose a different quality. However, now different groups may have conflicting preferences over the choice of the standard. The task of choosing an optimal minimum standard, thus, cannot be an easy one in this case.

III. Cost Uncertainty and the Break Down of Quality Maintenance

The model developed above shows how reputation can help preferred qualities prevail in markets with imperfect information. In such markets, the possibility of losing the returns on the initial investment in reputation removes the incentives for cheating when producers are certain about their cost and demand conditions. However, such incentives may reappear if uncertainties exist at either end of the firms' operations. For example, consider a situation where costs vary randomly and independently for each seller. For simplicity assume that the cost of producing one unit of quality q is equal to c(q) with probability b, and equal to Ac(q) with probability 1-b, where $A > 1$. In the context of our model, let us also assume that once sellers commit their resources for production in a period, they cannot leave the market; but they can learn about their cost situations at the beginning of the period and then decide what quality to offer [6]. If, as before, reputation is equal to the quality offered in the previous period and each seller commits himself to a given quality, the expected present value of reputation q can be found by the following asset equation [7]:

$$(11) \qquad V_M(q) = b[p(q)-c(q)+(1-e)V_M(q)/(1+r)] + (1-b)[p(q)-Ac(q)+(1-e)V_M(q)/(1+r)].$$

Or, solving for $V_M(q)$ and setting $b + (1-b)A = a$,

$$(12) \qquad V_M(q) = [p(q)-ac(q)](1+r)/(r+e).$$

Note that this result is essentially the same as (3), except that $ac(q)$--i.e., the expected cost of producing quality q--has now replaced $c(q)$. The free-entry condition in this case implies that

$$(13) \qquad p_e - ac(q) + (1-e)V_M(q)/(1+r) \leq 0.$$

Given that the minimum expected cost for entrants is $ac(q_0)$, an argument identical to the one made in the previous section shows that we must have $p_e = ac(q_0)$. Therefore, using (11), inequality (13), can be solved for $p(q)$ as:

$$(14) \qquad p(q) \leq ac(q) + a[c(q)-c(q_0)](r+e)/(1-e).$$

As in the certainty case, it is easy to show that if $p(q)$ is greater or equal to the upper bound set by (14), the seller of quality q will not find it advantageous to decide to reduce the quality of his product <u>prior</u> to the knowledge of his cost situation. However, now the seller has another option: he can decide to reduce the quality if costs turn out to be high. Our aim here is to show that under the free-entry condition (14), this 'non-commitment' (N) strategy is more profitable than the M-strategy.

Let us begin with the assessment of the expected present value of a strategy which produces quality q when costs turn out to be low and quality q_0 when costs are high. The asset equation of such a strategy can be written as:

(15) $V_N(q) = b[p(q)-c(q)+(1-e)V_N(q)/(1+r)] + (1-b)[p(q)-Ac(q_0)].$

Solving (15) for $V_N(q)$ yields:

(16) $V_N(q) = [p(q)-ac(q)+(1-b)A(c(q)-c(q_0))](1+r)/(1+r-b+be).$

Now let us ask under what conditions $V_N(q) > V_M(q)$. Comparison of (12) and (16) shows that this will be the case if [8]

(17) $p(q) < ac(q) + A[c(q)-c(q_0)](r+e)/(1-e).$

But (17) will clearly hold as long as (14) holds, since $A > a$. Therefore, with free entry, it will never pay for a seller to commit himself to a given quality prior to the resolution of his cost uncertainty. In fact, the free-entry condition will dictate that

(18) $b[p_e-c(q)+(1-e)V_N(q)/(1+r)] + (1-b)[p_e-Ac(q_0)] \leq 0$

which, after substitution for p_e and $V_N(q)$, and some manipulation, yields [9]:

(19) $p(q) \leq ac(q_0) + [c(q)-c(q_0)](1+r)/(1-e).$

A seller with reputation q can of course sell quality q_0 regardless of his cost situation and expect to earn $V_C(q) = p(q) - ac(q_0)$. The condition that makes this strategy inferior to the N-rule can be summarized as [10]:

(20) $p(q) \geq ac(q_0) + [c(q)-c(q_0)](1+r)/(1-e).$

Therefore, for each quality there is only one price that satisfies both conditions of free entry and of reputation maintenance in the low cost periods. That is, in equilibrium,

$$(21) \qquad p(q) = ac(q_0) + [c(q)-c(q_0)](1+r)/(1-e).$$

When costs of a single seller rise, no price in a competitive market can guarantee that he will maintain his quality. This result is mainly due to the fact that there are other sellers whose costs remain low and thus can continue to sell at competitive prices.

Given the price-quality relationship (21), the asset value of reputation q can be found as:

$$(22) \qquad V_N(q) = [c(q)-c(q_0)](1+r)/(1-e)$$

which is the cost of establishing reputation q under the favorable conditions of a low cost outcome. This is indeed why $V_N(q)$ here is exactly the same as $V_M(q)$ in case of certainty. Note that entrants who find their costs high will not attempt to establish a high reputation. But entrants, or existing sellers, with low costs are indifferent among various qualities, since they expect to earn a competitive rate of return--that is, the market rate of return adjusted by the risk of exogenous exit--on their investment. To see this point more clearly, we may write (21) so as to make it comparable with (8):

$$(23) \qquad p(q) = [bc(q)+(1-b)Ac(q_0)] + [c(q)-c(q_0)][r+e+(1-b)(1-e)]/(1-e).$$

The first term on the right hand side of (23) is clearly the expected cost of production, and the second term is the expected return on $V_N(q)$.

Given the uncertainty about the quality that each seller offers, reputation in this context can be interpreted as the quality that a seller will offer if his cost situation is favorable. Note that consumers cannot excuse the sellers who offer q_0 in one period as just having high costs and expect them to produce a high quality in the following period with the same probability that the established sellers do. The reason is that such expectations are certain to be proven inconsistent by the very incentives that they create for the sellers to cheat even when their costs are low. Therefore, consumers can only expect those sellers with reputation q to offer that quality with probability b. Thus, their expected utilities can be represented by $bU(u(q)+y-p(q))+(1-b)U(u(q_0)+y-p(q))$, which should be maximized over the price-quality alternatives that relation (21) offers. The first-order condition is

$$(24) \qquad b(u'-p')U_1' + (1-b)(-p')U_2' = 0$$

where U_1' and U_2' are the derivatives of U(.) evaluated at $u(q) + y - p(q)$ and at $u(q_0) + y - p(q)$, respectively. Differentiation of (21) results in $p' = (1+r)c'/(1-e)$, which can be substituted in (24) to find:

$$(25) \qquad u' = k(1+r)c'/(1-e),$$

where $k = 1 + (1-b)U_2'/(bU_1')$. Comparing (25) and (9) and assuming that the second-order conditions hold (see below), it is easy to see that to the extent that k is greater than one, the equilibrium quality will be lower in the presence of uncertainty. Note that two independent factors may be at work here. First, the more frequent the cost increases are, the larger $(1-b)/b > 0$ is going to be and the higher k

will rise above one. Second, this effect is strengthened to the extent that marginal utility declines with income, i.e., U_1' falls short of U_2'. The first effect is simply due to the fact that for any given reputation the expected quality is going to be lower the more often q_0 is offered in place of q. The second effect, on the other hand, is a result of "risk aversion" [11]. However, it is interesting to note that k and, therefore, the equilibrium quality, is independent of the magnitude of cost increase, A.

The second-order condition for consumer utility maximization can be written as:

$$(26) \qquad S = bU_1'(u''-p'') - (1-b)U_2'p'' + b(u'-p')^2U_1'' + (1-b)(p')^2U_2'' \leq 0.$$

The first term on the right-hand side of (26) is similar to what we had in the case of certainty. However, now three more non-positive terms are also trailing this condition and make its fulfillment all the more probable. Note that as in the certainty case, the same factors that lower the preferred quality determined by (25), also help make a sub-maximal outcome more probable.

If absolute risk aversion decreases with income, our model predicts that markets with high income consumers will have a tendency to produce higher qualities. This can be easily shown by differentiating (24) with respect to y,

$$(27) \qquad Sdq = [(1-b)p'U_2''-b(u'-p')U_1'']dy,$$

and by then substituting from (24):

(28) $\quad dq/dy = (1-b)U_2'p'[U_2''/U_2'-U_1''/U_1']/S.$

S in these expressions is defined by (26). According to (28), as long as absolute risk aversion, $-U''/U'$, is a declining function of income, dq/dy will be positive. This result may help explain part of the quality differences between similar products in developed and less developed countries, in addition to the possible explanation provided by the 'quality-is-a-luxury' argument. However, our model has other explanatory means for this phenomenon as well. In developed countries, producers tend to be large-scale mechanized units with easy access to efficient credit markets. Under these conditions, marginal costs tend to rise more slowly, expected lives of firms are longer, cost of credit is lower, and more importantly, cost variations are likely to be smaller and less frequent. These are all ideal conditions that help raise the average quality while reducing its variability. It is interesting to note that quality problems similar to those in today's less developed countries did exist in the past in the now developed countries. But, as Rashid (1985) observes in cases such as the milk market in the United States, these problems started to wither away as markets became more concentrated, which is exactly what our analysis suggests. This is not to say that no quality problems continue to exist in developed countries, as it is not unusual to hear complaints about automobile service in large cities. However, in developed countries, the range of such markets is much more limited and the enforcement of minimum quality standards is much more effective than in developing countries.

It is easy to see that minimum quality standards reduce the quality premium in this case, as they did in the case of certainty. A minimum standard may also help raise equilibrium the market quality, as differentiation of (24) with respect to q_0 shows:

(29) $$dq/dq_0 = (1-b)p'(q)u'(q_0)U_2''/S > 0.$$

In the next section we will further argue that demand variations may also give rise to the quality problems. Again producers in concentrated oligopolistic markets are less likely to experience demand variations than those in the highly competitive markets where each producer serves only a few customers. The model thus helps explain the quality puzzle in competitive markets and underlines the limitations of reputation in solving market failures in the presence of uncertainty and imperfect information. Furthermore, our analysis points to the roles of technology, of market organization, and of efficiency in credit markets as the sources of quality problems in competitive market. These are certainly important factors to be considered in the design of deregulation and anti-trust policies, such as the ones towards the airline industry, banking system, and telephone services in the U.S. in recent years. The problems pointed out here obviously indicate possible flaws in the widely-held premise of the unquestionable advantages of greater competition.

It is, finally, important to point out that the results obtained above are by no means specific to the simple reputation function (1) that we have used so far. For example, take the case of the more general adaptive expectations $R_t = \gamma R_{t-1} + (1-\gamma)q_{t-1}$, where $\gamma \leq 1$ is the reputation adjustment coefficient. It can be shown that the quality-maintaining price in this case has to be:

(30) $$p(q) = ac(q) + a[c(q)-c(q_0)](r+e)/[(1-e)(1-\gamma)].$$

However, the non-commitment strategy dominates the quality-maintenance one at this price, and with free entry, the competitive price declines to:

(31) $$p(q) = ac(q_0) + [c(q)-c(q_0)](1+r)/[(1-e)(1-\gamma)] - [c(\gamma q+(1-\gamma)q_0)-c(q_0)]/(1-\gamma).$$

The asset value of reputation q in this case is

(32) $$V_N(q) = [c(q)-c(q_0)](1+r)/[(1-e)(1-\gamma)],$$

which is the cost of gradually building up reputation q under low cost conditions. Note that if $\gamma = 0$, (31) and (32) will reduce to (21) and (22), respectively. On the other hand, as γ rises, the premium on quality increases. That is, the longer the lag in the adjustment of reputation, the larger has to be the investment in reputation and the higher have to be the prices that guarantee that high qualities are produced at all. Longer adjustment lags are often themselves a result of noisy information received by consumers. For example, unless one subjects milk to sophisticated tests, it is hard to detect its exact composition. Thus, consumers may tend to discount a few "observations" of a seller's product quality and wait for a while before they come up with a verdict. In this respect, minimum quality standards and modern measurement tools may help increase the amount of information and, thus, reduce the premium on quality.

IV. Demand Uncertainty and Further Generalizations

In this section we study the effects of demand uncertainty on the choice of quality by monopolistic producers. We will show that as in the case of cost uncertainty, quality-maintenance is not a dominant strategy in the presence of demand uncertainty and that a non-commitment one is likely to prevail. We will derive this result for a monopolist seller first, and then discuss its implications for a market with monopolistic competitors. Also, the model is set up in a more general framework to show that the main results of Section III are not specific. In particular, since in this model the produced quantity is endogenous, the exercise will help demonstrate that the fixed-output assumption has not been crucial in our previous analysis.

Let us assume that a monopolist faces a stochastic inverse demand curve $Kp(R_t,x_t)$ where x_t is the quantity of output and K is a random variable such that K = 1 with probability b and K = A > 1 with probability 1 - b. As in Section III, the seller learns about his demand situation at the beginning of each period, and then makes a decision about the quality and quantity that he wants to offer. For the formation of reputation, we assume a general function of the form $R_t = R(q_{t-1},q_{t-2},\ldots)$, which can allow reputation to depend not only on a moving average of the past quality record, but on its variability as well [12].

Given the monopolist's initial reputation and the choice of quality in period t, his maximum profits can be defined as:

$$W(q_t,R_t,K) = \max_{x_t} Kp(R_t,x_t)x_t - C(q_t,x_t) \tag{33}$$

where $C(q_t, x_t)$ is the cost of producing x_t units with quality q_t. The first-order condition for (33) is:

$$(34) \qquad K(\partial p/\partial x_t)x_t + Kp(R_t, x_t) - \partial C/\partial x_t = 0.$$

This equation can in principle be solved for x_t as a function of R_t, q_t, and K. The second-order condition,

$$(35) \qquad T = K(\partial^2 p/\partial^2 x_t)x_t + 2K(\partial p/\partial x_t) - \partial^2 C/\partial^2 x_t \leq 0,$$

is likely to hold as long as the second derivative of p(.) with respect to x_t is not a positive large number. If (35) is satisfied, x_t will be larger the greater K is, since

$$(36) \qquad dx_t/dK = -[(\partial p/\partial x_t)x_t + p(R_t, x_t)]/T = (\partial C/\partial x_t)/KT > 0.$$

Here we have first differentiated (34) and then used it to simplify the relationship. Therefore, for a given quality, if an optimal level of output exists, it will expand as the demand rises. In particular, if the monopolist decides to market the same quality q in the first period irrespective of the demand situation, we will denote his output by x when K = 1, and by x_A when K = A. We know that $x_A > x$.

The monopolist's expected profits when he follows such a pre-commitment strategy can be written as:

$$(37) \qquad V_M(q, R_1) = bW(q, R_1, 1) + (1-b)W(q, R_1, A) + V_F(q, Q)$$

where $V_F(q, Q)$ is the maximum expected present value of the monopolist's profits in the second period and thereafter, given the choice of quality in the first period and the vector of qualities in the

previous ones, Q. Choices of past qualities affect future earnings only through reputation, which has been suppressed here without loss of generality. To maximize V_M, q must now be chosen such that

$$(38) \qquad \partial V_M/\partial q = b\partial W(q,R_1,1)/\partial q + (1-b)\partial W(q,R_1,A)/\partial q + \partial V_F/\partial q = 0.$$

Now consider the present value of a non-commitment strategy according to which quality in the first period should be changed by dq if demand turns out to be low.

$$(39) \qquad V_N(q,R_1) = bW(q,R_1,1)] + (1-b)W(q+dq,R_1,A)$$
$$+ bV_F(q,Q) + (1-b)V_F(q+dq,Q).$$

Expanding the terms with differentials and using (37) and (38) we find:

$$(40) \qquad V_N(q,R_1) = V_M(q,R_1) + (1-b)[\partial W(q,R_1,A)/\partial q_1 + \partial V_F/\partial q]dq$$
$$= V_M(q,R_1) + (1-b)b[\partial W(q,R_1,A)/\partial q_1 - \partial W(q,R_1,1)/\partial q]dq.$$

But, by differentiating W(.) and using (34), it is easy to show that:

$$(41) \qquad \partial W(q,R_1,A)/\partial q-\partial W(q,R_1,1)/\partial q = \partial C(q,x)/\partial q - \partial C(q,x_A)/\partial q.$$

Therefore, since $x_A > x$, the sign of the coefficient of dq depends on the sign of $\partial^2 C/\partial q\partial x$. If the marginal cost of quality declines with output, the coefficient of dq in (40) will be positive and the monopolist will do better by raising the quality when demand booms. On the other hand, if the marginal cost of quality rises with output, the monopolist will find it profitable to lower his quality at the

time of high demand. This last result is a reminder of the familiar situations when some businesses with limited capacity tend to lower the quality of their services when their demands are unusually high.

The above analysis would be essentially unchanged if we consider a market with many monopolistic competitors. The main difference is that now the demand function depends on the actions of other sellers. In fact, a great deal of demand uncertainty for each seller in this case may come from the independent activities of other sellers. For instance, if quality production suffers from diseconomies of scale, an increase in the demand for a seller induces him to lower his product quality. This act lowers the reputation of this seller in the following periods and derives away some of his customers towards other sellers who in turn may take this as a positive shock and respond by quality deterioration. Thus, part of the demand variation in such a monopolistically competitive market can be endogenous and will tend to disappear as the firm sizes grow and as the market becomes more concentrated. It is interesting to note that diseconomies of scale in quality production is more likely to exist in markets with numerous small sellers, since economies of scale naturally help a few enterprises to grow and to dominate the market. Therefore, the technological factors that keep the producer sizes small may add to the demand variability and create quality problems as well.

The application of the above technique to the case of cost uncertainty is straightforward. The main point will be retained: quality variation can be shown to be a rational response to demand or cost uncertainties. Since such uncertainties are more likely exist in

markets with numerous small producers, low and variable qualities also tend to appear more often in markets with competitive characteristics.

V. Conclusion

The purpose of this study was to answer the question why low and variable product qualities are mainly observed in markets with a multiplicity of sellers and with free entry. This question turns into a puzzle when one observes that such quality problems occur in markets where uniform and high quality should normally be preferred by all consumers; e.g., the milk market in some less developed countries. Such problems may perhaps be more understandable in monopolistic markets where sellers are in a position to exploit the buyers. In competitive markets, however, even if there are informational difficulties, one expects institutions such as reputation to be able to solve quality problems more easily.

In this paper, we have suggested that uncertainties that exist in cost or demand functions of small producers may be the clue to the above quality puzzle. Such uncertainties make the sellers' commitment to a uniform quality unprofitable, and therefore encourage quality variation. Consumers may of course be willing to pay higher prices for higher qualities, but free-entry puts a ceiling on the price of each quality such that sellers find it profitable to offer that quality only as long as their cost or demand situations remain favorable. If, for example, costs of some sellers rise while those of others remain low, the former will not find it worthwhile to maintain their reputations. In this analysis, independence of cost shocks to individual producers is a key part of the explanation for simultaneous

price stability and quality variation in petti-seller markets. Cost uncertainties may of course exist in oligopolistic markets as well, but the frequent and independent shocks that strike small producers are likely to average out for larger enterprises.

We have also found that quality problems can be exacerbated by high and variable interest rates, rapidly rising marginal costs, and short expected lives of firms; all of which tend to raise the costs of production and of maintenance of higher qualities. These factor are also often closely associated with competitive petti-seller markets, particularly those of the less developed economies. The notorious credit markets in such economies may especially be responsible for the high and variable production costs and, therefore, for the low and variable qualities.

Quality problems may also arise in monopolistically competitive markets with uncertain demand. Again, the smaller and the more numerous the sellers are, the greater would be the demand uncertainty of each seller; especially the kind of uncertainty associated with the inter-firm flow of buyers which normally averages out for larger enterprises in concentrated markets. We have also found that in monopolistically competitive markets where diseconomies of scale in quality production are more likely, product quality tends to decline in response to sudden surges of demand. This effect can induce a greater turnover of buyers in such markets and, thus, exacerbate the quality problem by increasing the demand fluctuations for individual sellers. The same effect may also help explain serious quality problems in some less developed countries where demand has experienced rapid growth

rates. Some oil-exporting countries, and particularly the notorious situation in Nigeria, are cases in point.

Finally, risk aversion in the face of uncertain quality is another factor which may induce consumers to satisfy themselves with lower qualities despite their strong preferences for the best; e.g., pure milk. The poor may especially be hesitant to pay a high price for a high quality and take the risk of ending up with a low one. This effect, together with those mentioned above, go a long way towards explaining certain quality problems in seemingly competitive markets. They also provide a much better understanding of the quality differences between similar markets in developed and less developed countries.

Minimum quality standards can reduce the above mentioned problems significantly. But this solution is also more feasible when producers are large and quality measurement and control is not costly. That is, exactly when the market itself has a tendency to produce a high and uniform quality. Such tendencies should certainly be taken into consideration in regulation, deregulation, and anti-trust policy-makings.

Notes

[1] Rashid (1985) does not discuss the variability of quality explicitly, but it is certainly an integral part of quality problem [see Bardhan and Kletzer (1984)]. Consumers get to know higher quality products at times, but they learn not to keep their hopes high all the time.

[2] The basic results of this section will not change if we use other more general reputation functions (see Shapiro, 1983). An example of such a generalization is considered at the end of Section III.

[3] Because of free entry, the expected return on reputation q_0 is the same as the expected gain of a new entrant, i.e., zero.

[4] That is, the percentage of entrants with minimal quality, s, will be such that consumers of quality q will be left indifferent between existing and new sellers. In terms of the consumer utility function that we are going to specify below, s is determined by

$$U[u(q)+y-p(q)] = sU[u(q_0)+y-c(q_0)] + (1-s)U[u(q)+y-c(q_0)].$$

It is assumed that in equilibrium, buyers' expectations about the probability of high quality among entrants is consistent. Note that this argument is different from that of Shapiro (1983) who assumes a continuum of consumers with at least one group that prefers to buy the minimal quality at the going prices.

[5] Indeed, if they are sophisticated enough and know the cost structure, they may even refuse to purchase from sellers who charge a lower price. Allen (1984) has used this idea to show that with seller rationing, suboptimal production levels may raise the average cost and replace the need for the initial investment. However, examination of this point is beyond the scope of the present paper.

[6] In the rice market, yields may vary and in the milk market, cows may produce variable quantities at different times. The seller then has to make a decision as to how much the product should be diluted after he observes the quantity produced. Note that in these examples quantity of the product is variable, while we have assumed fixed quantity for each seller. The generalization of the model in Section IV will show that variability of quantity does not change the main point of this exercise.

[7] Reputation in this case may depend not only on the past qualities offerred, but also on the variability of quality in the past as well. As we will argue in the next section, the essential results of the model will survive even if we use a more general reputation function of the form $R_t = R(q_{t-1}, q_{t-2}, \ldots)$ which may include the effect of quality variability.

[8] Note that $V_N(q) > V_M(q)$ can be written as:

$$(r+e)[p(q)-ac(q)+(1-b)A(c(q)-c(q_0))] > (1+r-b+be)[p(q)-ac(q)].$$

Transferring $(r+e)[p(q)-ac(q)]$ from the left-hand side to the right results in:

$$(r+e)(1-b)A[c(q)-c(q_0)] > (1-b+be-e)[p(q)-ac(q)].$$

Now, factoring out (1-b) in the parentheses on the right-hand side simplifies this relationship to:

$$(r+e)A[c(q)-c(q_0)] > (1-e)[p(q)-ac(q)],$$

from which (17) easily follows.

[9] Note that (15) can be written as:

$$(15') \quad V_N(q)-[p(q)-p_e] = b[p_e-c(q)+(1-e)V_N(q)/(1+r)] + (1-b)[p_e-Ac(q_0)]$$

The expression on the right-hand side of (15') is the same as the one on the left-hand side of (18). Therefore, noting that $p_e = ac(q_0)$, we find:

$$(16') \quad V_N(q) \leq p(q) - ac(q_0).$$

Substitution from (16) yields:

$$[p(q)-ac(q)+(1-b)A(c(q)-c(q_0))](1+r)/(1+r-b+be)$$
$$\leq p(q) - ac(q_0) = p(q) - ac(q) + a[c(q)-c(q_0)].$$

Multiplying both sides by (1+r-b+be) and moving some terms around result in:

$$b(1-e)[p(q)-ac(q)] \leq [(1+r-b+be)a-(1+r)(1-b)A][c(q)-c(q_0)]$$

which simplifies to (19) after $a = b + (1-b)A$ is taken into consideration.

[10] The proof of this result is very similar to the one given in footnote [9].

[11] Producers in this model are assumed risk neutral, while consumers may be risk averse. This asymmetric treatment can be removed by examining the effects of risk aversion on the part of producers. The result would be higher premiums and lower equilibrium qualities.

[12] Note that varying product quality over time may be part of the monopolists optimal strategy (see Shapiro, 1982). However, in this section, our main point is that demand uncertainty can be an additional source of quality variation.

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Figure 1

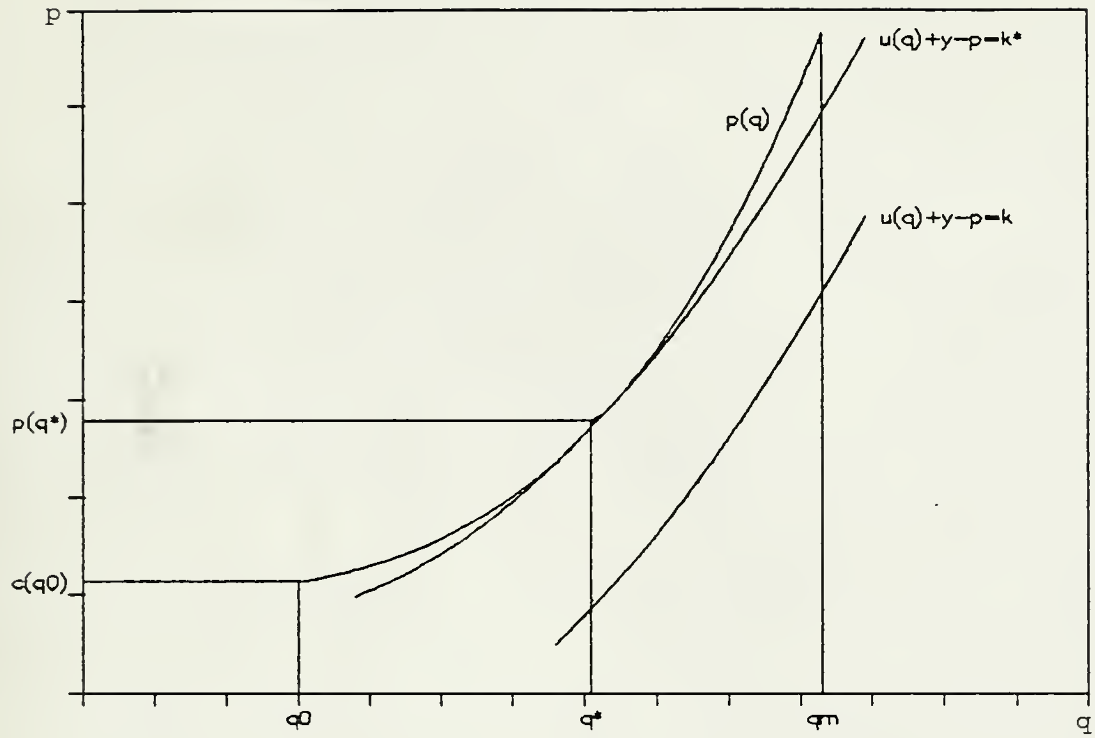


Figure 2

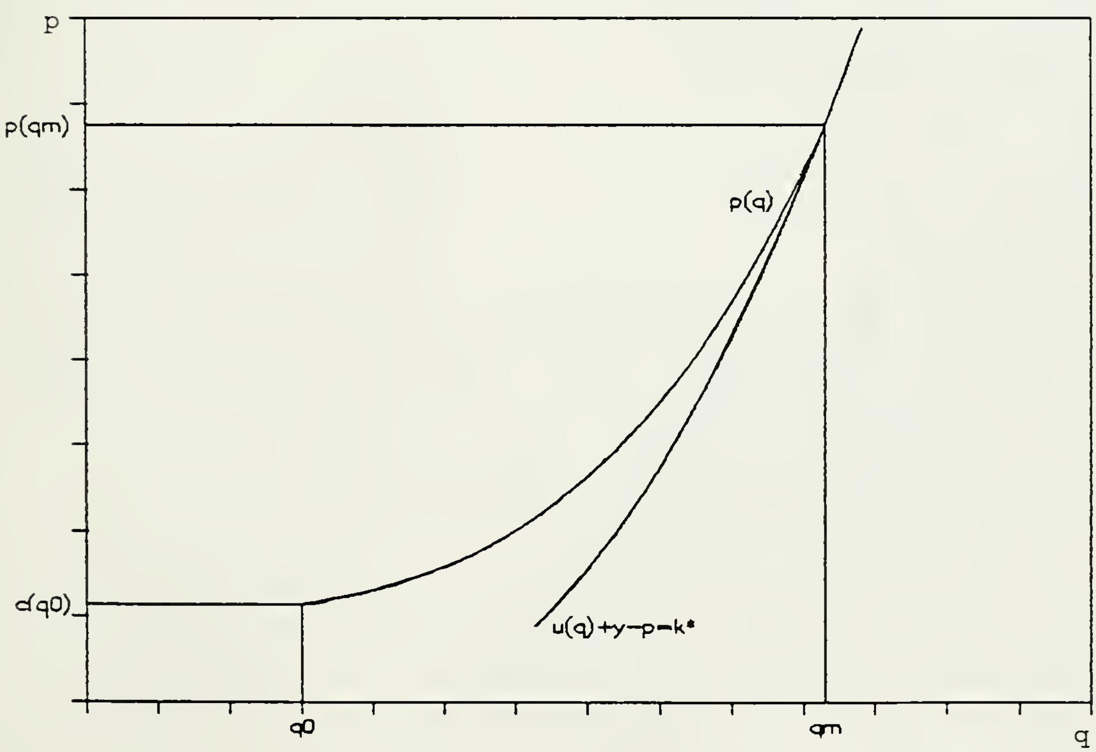
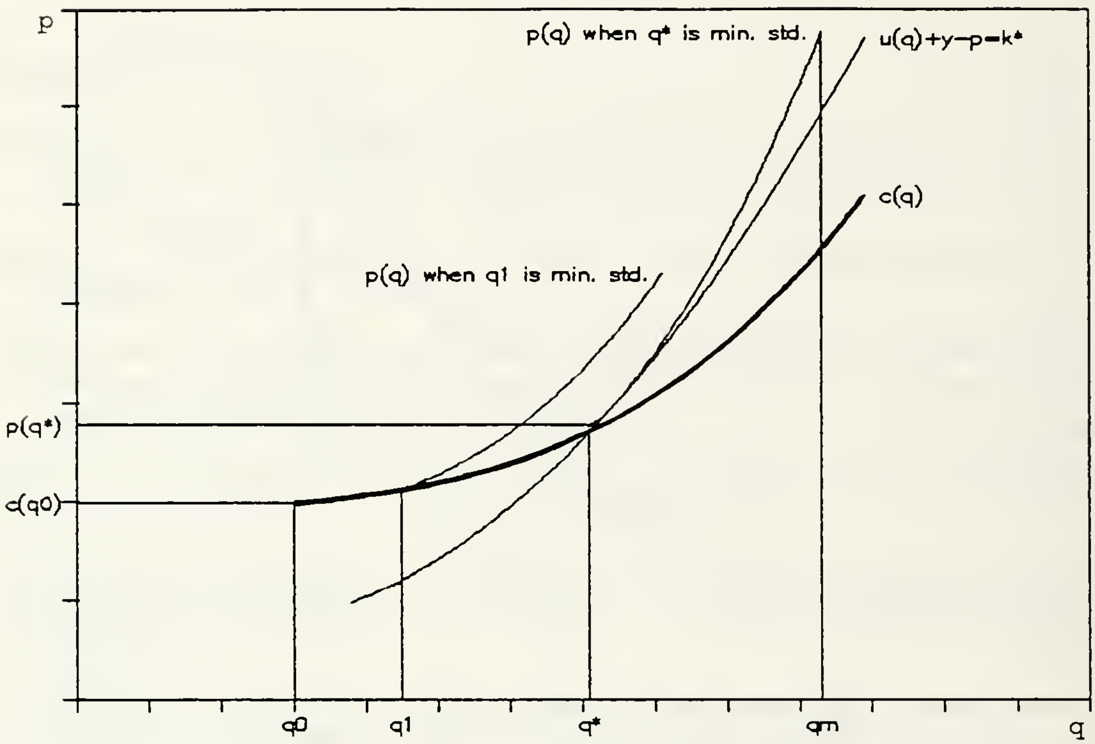


Figure 3



p
p(q) when q* is min. std.
u(q)+y−p=k*
c(q)
p(q) when q1 is min. std.
p(q*)
c(q0)
q0
q1
q*
qm
q

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PAPER NO. 1262

The Relation of Education and R&D to Productivity Growth in the Developing Countries of Africa

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